WP 3.1 Poland

Inventory of demoprojects

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3.7 – Poland, Country description

Introduction

Size of country	Total land area: **31267,9 thous. ha** (in which: land under water: 638,2 thous. ha) Agricultural land: **18981 thous. ha**, of which arable land 18243 thous. ha (96,1%) Forest land as well as woody and bushy land: **9496 thous. ha** Legally protected areas possessing unique environmental value (23 national Parks, including those created on the basis of gmina resolutions, 1441 reserves, since 2005 excluding Natura 2000 areas, excluding coast waters of the Baltic Sea (in 2008 — 11171 ha), excluding surface of the Pomeranian Gulf (2804 ha)): **10112,5 thous. ha** (32,3 % of total area of the country)
Population indicators	Inhabitants: **38135876 (2009)** Inhabitants per km^2: **122**
Economic indicators	GDP: **567 bn $ (2008)** GDP per capita: **$ 14.875** (population in 2008: 38116 thous.)
Energy indicators	Total primary Energy Production: **3284,4 PJ (2007)** Primary Energy Indigenous Production: **3034382 TJ (2007)** Of which: Peat and wood: **129412 TJ (2007)** Hydro and wind energy: **10345 TJ (2007)** Geothermal energy: **439 TJ (2007)** Biogas: **2709 TJ (2007)** Solid Biomass and animal products: **61098 TJ (2007)** Total primary Energy Consumption **4137,1 PJ (2007)** Total Consumption of Electricity **502,5 PJ (2007)** (where Electricity from RES 4,7 % - **23,62 PJ,** RES-E target 2010: 10,4%) Primary Energy Import: **1395539 TJ (2007)** Primary Energy Export: **342116 TJ (2007)** Stock Change: **-23370 TJ (2007)** Total Energy Import: **1777816 TJ (2007)** among which Bunker: **6457 TJ (2007)** Total Energy Export: **721469 TJ (2007)** Stock Change: **11552 TJ (2007)** CO_2 emissions: **330524 Gg (2006)** CO_2 emissions per capita: **8,67 tCO_2** (population in 2006: 38132 thous.)
Availability of Biomass resources	Theoretical potential: **895 PJ/a**

Sources: Mały Rocznik Statystyczny 2008 GUS, Warszawa 2008.,
Energia ze źródeł odnawialnych 2008. GUS, 2009
Gospodarka paliwowo-energetyczna w latach 2007,2008, GUS, Warszawa 2009

Poland is a medium-size country, with an area of 312 679 km^2 (including inland waters as well as a part of internal waters), situated in the central-eastern part of Europe. Poland is a Baltic state.
In 2008 the population of the country was 38,136 million inhabitants, of which 23,288 million (61,1%) was urban and 14,848 million (38,9%) rural population. The average density of population was 122 inhabitants per 1 km2.
Poland is an agricultural and industrial country with high area of agricultural land and forests. The predominance of lowlands, ca. 75,1% of the total area is very conductive to agriculture. The areas elevated between 200 and 300 m above sea level equal to 16,2%, between 300 and 1000 - 8,5%, and only 0,2% of the area is 1000 m above sea level.
In 2007 agriculture land covers the area of 19 069 thous. ha, in this arable land orchards, permanent meadows and pastures of 18 333 thous. ha. Forest land as well as woody and bushy land covers 9 491 thous. ha and wasteland 489 thous. ha.
In 2007 the share of agricultural land in the total area of the country was about 61% and the share of forests and woods ca. 30%.
The area of devastated and degraded land requiring reclamation and management in 2006 was 65 thous. ha (0,2% of the country total area.). Devastated and degraded land is a land which has lost its utility value as well as land the utility value has declined due to a worsening in natural conditions or environmental changes and industrial activity, etc.
Main industries are: fuel and power industry, iron and steel, machine and electrical engineering, electrical electronic, metal, chemical, mineral, food, timber, paper making, light industries.
In 2007 GDP reached 1 271734 million PLN (ca. 31783 million Euro), 27,8 thous. PLN per capita (6,95 thous. Euro per capita). The GDP rate reached: 6,2% in 2006, 6,6% in 2007 and 4,9% in 2008.

3.7.1 - Energy from Renewable sources of energy

Renewable Energy Sources (RES) are a new entrant to the energy supply market in Poland, which has been so far dominated by coal. In the development of the RES sector, the policy instruments will play a very important role. Those are driven mostly by Poland's international obligations, such as meeting the Kyoto targets or complying with the EU directives, notably with the Biofuel Directive 2003/30/EC and the Green Electricity Directive 2001/77/EC. On the domestic side, with more than one hundred thousand people still employed in the coal-mining sector, the coal lobby is powerful and, one could expect, that they should perceive the RES as a competitor. However, the real competitor for coal is natural gas, which has been heavily subsidised as a "environmental" fuel, leading to massive conversion from coal to gas heating in cities and also in rural areas. As many experts believe, there is no rational justification for promotion of natural gas considering that it is also a fossil fuel and recent experiences with certainty and stability of supplies show that such conversion is a risky entertainment. One should note that subsidies to conversion to natural gas have devoured a lion's share of environmental funds earmarked for subsidies for "greening" the energy in Poland. On the other hand, the demand for coal from the Polish power industry – the main coal consumer – is not seriously threatened by the renewable energy sources, at least in the foreseeable future. Indeed, the renewable energy resources that could replace coal in power generation in Poland are not particularly abundant. Poland, being a predominantly flat country, possesses relatively small hydro-energy potential. The same applies to wind energy: in reality, contrary to some enthusiastic forecasts, relatively good wind conditions exist only at the Baltic coast, where neither local demand is high nor transmission capacities to central Poland are sufficiently developed.
The assessments of RES potentials vary considerably, however the above mentioned observation is rather not challenged.
Poland has relatively large resources of solid fuels (hard coal and brown coal), modest reserves of natural gas, insignificant of crude oil. Among the renewable Poland has con-

siderable resources of biomass. There is also a possibility of wider application of wind and geothermal energy.
In 2007 energy production from renewables reached 208 666 TJ (6,9% of total primary energy production and in 2006 respectively 210 552 TJ – 6,5% of total primary energy production. Biomass is the dominant source and has large share of utilization, for local heating (ca 70%), for electricity ca. 29% and 1% for district heating).
Electricity production from RES reached 6,2 TWh (according to Green Certificates to February 2009, and RES installed capacity was 1678 MW in 2008. Biomass and biogas power plants produce ca.47% of RES electric energy in 2007.
On 9th of July 2009 the Ministry of Economy accepted a program: "Innovative Energy – Energy Agriculture" (Innowacyjna Energetyka – Rolnictwo Energetyczne) which allows to create in every district on average one biomass processing facilities using biogas of agriculture origin up to 2020.
The program is focused on creating optimal chances to develop installation producing biogas in agricultural processes, indication of joint financing such investments from public and local sources and EU funds, as well as, conducting promotional and educational tasks.
It is to be estimated that existing resources should allow producing around 5 billion cubic meters of biogas of similar to high methane gas quality parameters and therefore construction of 2000 – 2500 biomass processing facilities and biogas producing units – 1 MW capacity each.

Table 1. RES balance in Poland in 2008 [TJ]

Item	Indigenous production	Import	Export	Stock changes	Total consumption
Biomass	198 401	-	-	500	198 902
Solar energy	54	-	-	-	54
Hydro energy	7 748	-	-	-	7 748
Wind energy	3 012	-	-	-	3 012
Biogas	5 515	-	-	-	5 515
landfield	1 432	-	-	-	1 432
- sewage	3 976	-	-	-	3 976
other	107	-	-	-	107
Liquid biofuels					
bioethanol	2 459	3 027	11	-184	5 291
biodisel	9 943	3 547	-	-279	13 211
Geothermal energy	531	-	-	-	531
Municipal waste	9	-	-	-	9
RES	227 672	6 574	11	37	234 273

Source: Energia ze źródeł odnawialnych w 2008 r. GUS, Warszawa, 2009.

3.7.2 - Energy from biomass

Poland's potential of biomass is relatively very high. Technical potential is estimated from 408 PJ/a to 755 PJ/a. (depends on sources).
A potential of wood biomass is estimated at about 24,5 PJ /a to 59 PJ /a ie.: 5 234 000 m3, (3 101785 000 kg). The potential of wood from orchard is estimated at about 15 PJ/a to 22PJ/a. [Grzybek, 2008].
The technical potential for biogas production is estimated at about 674 million m3 i.e. 26 PJ, and municipal waste at 2 million ton/a, and 8 million waste disposal.
The biomass economic potential, defined as a technical potential that can be provided at economically profitable levels, is estimated from 160 PJ/year to 600 PJ/year. (depends on sources).

Table 2. Economic potential of biomass and their utilization in 2006

Biomass	Economic potential	Utilisation Share of the potential	
	PJ	PJ/year	%
Solid dry biowaste	166	161	97
Biogass	123	2,6	2,1
Forestry products	24,5	24,5	100
Agriculture residues	287	4	1,4
TOTAL	600	192	32

Source: G. Wisniewski, K. Michałowska-Knap, EC BREC IEO, conference paper, Wroclaw 2008.

Biomass is applied in power sector mainly in co-firing with coal and in a small scale – in individual houses, estates, on the countryside, and in small towns as a dispersed energy production in Poland.
The energy policy specifies strategic objectives of the RES as follows:

- achieving 15% RES in 2020 in final energy use,
- achieving 10% share of biofuels in the liquid fuels market by 2020, and increase use of the second generation biofuels,
- forest protection against excessive exploitation for biomass, and sustainable use of arable land for RES.

According to these objectives final energy demand from RES is presented in a table 3.

Table 3 . Final energy demand from renewable energy sources 2006 – 2030 [PJ]

	2006	2010	2015	2020	2025	2030
Electricity	16	30	63	112	136	142
Solid biomass	7	12	21	37	40	42
Biogas	1	1	6	14	23	25
Wind energy	1	7	26	49	62	64
Water	7	9	10	11	12	12
Photovoltaic	0	0	0	0,004	0,05	0,09
Heat	181	188	211	262	295	319
Solid biomass	178	181	192	226	246	265
Biogas	1	3	11	21	31	33
Geothermy	1	3	6	9	12	15
Sun	0	1	2	5	5	6
Transport fuels	4	23	37	60	68	79
Bioethanol	3	6	10	18	19	21
Biodiesel	1	17	27	29	27	27
Bioetanol II gener.	0	0	0	9	10	10
Biodiesel II gener.	0	0	0	5	9	10
Bio-hydro	0	0	0	0	4	10
Total gross final energy from RES	200	241	312	435	500	540
Gross final energy	2588	2567	2679	2897	3160	3373
Share of energy from RES [%]	7,7	9,4	11,6	15,0	15,8	16,0

Source: Energy Policy by 2030

To reach the 2030 targets biomass should grow rapidly, taking efficiency into account in:

- heating (individual heating, heat plants, district heating CHP);

- electricity: CHP, cofiring to fossil power plants, alone plants, microcogeneration using steam engine, gasification;
- transport: first generation fuels, second generation fuels, biomethan from biogas, others.

The energy policy should enhance the financial supports, tax incentives and promotion programmes of biomaterials.
On 9th of July 2009 the Ministry of Economy accepted a program: "Innovative Energy – Energy Agriculture" (Innowacyjna Energetyka – Rolnictwo Energetyczne) which allows to create in every district on average one biomass processing facilities using biogas of agriculture origin up to 2020.
The program is focused on creating optimal chances to develop installation producing biogas in agricultural processes, indication of joint financing such investments from public and local sources and EU funds, as well as, conducting promotional and educational tasks.
It is estimated that existing resources should allow producing around 5 billion cubic meters of biogas of similar to high methane gas quality parameters and therefore construction of 2000 – 2500 biomass processing facilities and biogas producing units – 1 MW capacity each.

3.7.3 - Demo projects (plants/systems) inventory

Table 4 - SMALL – MEDIUM – LARGE SIZE BIOMASS PLANTS
Thermal Energy Plants (kWth)

kWth	Technology (1)	Biomass Type (2)	Biomass Source (3)	Biomass Consumption t/a	Residue Usage (4)	Running Time h/a	Efficiency % (5)	Employment (6)
<1000 Zielonki	2x 500kW	cereal and rape straw	local farms	550-620 t/a	partly as fertilizer	550-620 t/a	88	Single stoker and seven-person group for the harvest of straw. Local farmers as a fuel suppliers.
<1000 Trzcianne	41 x (15-30kW) Batch boilers with accumulation of the heat in the water tank. First project in Poland, implemented as a package of single investments (project packaging).	Waste wood (from the maintenance over forests and orchards), hay, straw	from the maintenance forests and orchards	5 t/a x 41	partly as fertilizer	3000 h/a continued use of the boiler with the full load if needed and 1000 hours for domestic hot water beyond the heating period.	85	Own maintenance and local, trained conservators Fuel suppliers: farmers' own forests, orchards, State Forests, local sawmills

>1000 LUBAŃ	Straw fired boilers with total capacity 8 MW. SSM: 1 MW straw boiler, with dedicated equipment, two straw boilers 3,5 MW each, straw storage buildings 800 + 1060 m2.	cereal and rape straw	from the surrounding farms (agriculture)	3 000 - 5 500 t/a	partly as fertilizer	Whole year	84%	15 people - boiler room stokers, in the summer operating equipment to harvest straw; fuel supplier - the surrounding farms
CHP Eventual								
Other								
Note:								

(1) Combustion, Gasification, Pyrolysis, etc.. (Short description of the components for medium-large size plant)
(2) Pellet, chips, briquette, logs, sawdust, vegetal oil, biodiesel, etc..
(3) Domestic, import, local availability, distance of source, etc.
(4) Recycle, agricultural use, by-products, waste, etc.
(5) Thermal, electric, total.
(6) Local, direct, indirect, possible improvement, etc.

Table 5 presents Installed capacity and electric energy production from RES in 2005-2006.

Table 5. Installed capacity and electric energy production from RES in 2005-2006

Type of RES	2005			2006		
	No. of plants	Installed capacity	Energy production	No. of plants	Installed capacity	Energy production
	No.	MW	MWh		MW	MWh
Electric biomass plants	7	189,8	467975,7	6	238,8	503846,2
Biogas plants	67	32,0	104465,3	74	36,8	116691,9
Wind plants	64	83,3	135291,6	104	152,6	257037,4
hydro	672	922	2175559,1	684	931	2029635,6
Co-combustion	16	-	877009,3	18	-	1314336,6
Total	826	1307,5	3760301,0	886	1509,5	4221547,7

Source: Główny Urząd Statystyczny: „Ochrona środowiska 2007”, Warszawa, 2007r

Three successful biomass heating projects
(Selected from many others)

1. District heating plant in the city of Luban (8 MW, straw)

2. First biomass boiler in Poland: 1 MW straw in the former state-collective farm in Zielonki
3. First packaged biomass heating project in Trzcianne:
   41 individual biomass boilers (15-31 kW) + 3 public buildings (ca. 100-200 kW)

3.7.3.1. Luban

8 MW district heating plant:
2 x 3,5 MW (Polish make) + 1 MW (Danish)

It was first project in Poland that include complete modernisation of district heating system (demand side management, DSM) with a strong use of RES (supply side management, SSM). Additionally, model contracts with local farmers securing fuel supply were signed.
Fuel is bailed straw from the surrounding agricultural farms.
SSM included: 1 MW straw boiler, with dedicated equipment, two straw boilers 3,5 MW each, straw storage buildings 800 + 1060 m2. The heating company also bought three straw bailing machines, three tractors, two loaders, two low landing gear platforms to secure regular supply of raw material.
DSM measures included: seven new and modernization of 27 heating systems (installation of building heat control systems, high performance heat exchangers and heat meters) plus seven brand new systems installed.
Straw-fired boilers are based on locally harvested fuel. Energy and economy security are ensured by coal boilers (about 70% of heat production), optimization of cost and security of supply in the straw supply is provided by its own system for collection of fuel.
Basic equipment of boilers consists of: preparation and transportation of straw equipment, stepped grate, automation and control system.
The basic requirement of the selection of boilers for straw was flexibility regarding moisture of straw and resistance to mechanical damage. A feeder chain moves to the straw bales to the shredder. Shredded straw is fed to the boiler combustion chamber using a screw feeder through the fire airlock. Combustion on the grate and the chamber of the boiler is automatically controlled. Low-speed chopper shreds straw bales with moisture content up to 23%. Straw shredder cuts short cuts, making it impossible to wrap the straw around the axis of the feeders. Boilers are equipped with stepped grates with adjustable primary, allowing an optimal adjustment of the fuel combustion of varying quality. Nominal efficiency of straw combustion in boilers is approximately 84%.

Biomass consumption - 3000-5500 t/a
Savings of heating fuel: Coal - 1 500 - 2 500 t/a
The heat is supplied to a housing establishment of ca. 15 000 inhabitants

The main advantages of the project are:

- avoided costs of purchasing coal, financial savings
- more efficient use of employees,
- revenues from the sale of CO2 emission allowances
- diversification of supply sources,
- environmental protection

The main negative aspect of the project is big straw sensitivity to weather conditions, a significant impediment to the operation of the plants at high humidity fuel.

In further perspective, generation of electricity from straw in the event of favourable economic relations is considered.

3.7.3.2. Zielonki

Zielonki housing estate:

It was first biomass heating system in Poland. The project included modernisation of local coal fired to straw fired heat plant, which is used for heating 160 housing unit of former state-owned farms. The investment accomplished at September 26, 1996. The overall cost of the project, which include building the new heating pipeline was 1120.000,00 PLN. The thermal capacity is 1 MW = 2 x 500 kW. Biomass consumption is 550-620 t/a and savings of heating fuel: Coal 520 t/a. Nominal efficiency of straw combustion in boilers is approximately 88%.
The heating plant secures 100% of heat demand for space heating in buildings, relying on local biomass fuel - straw.

The main advantages of the project are:
- Becoming independent from external supplies of fuel,
- financial savings,
- employment,
- environmental protection.

The main negative aspect of the project was no thermal renovation before the investment.

3.7.3.3. Trzcianne

Trzcianne individual farms:
first successful packaged project in Poland

In recent analyses of the barriers, which hamper the development of biomass energy in the new member states emphasis is often put on the investment cost, which is too high for individual households, especially in rural areas, to install a new biomass boiler. The agricultural sector in Poland is dominated by small and medium-sized farms. It has been estimated that about 400 000 farms could convert their heating systems from low quality coal, they use at present, to biomass produced locally, mostly self-produced. However, the main barrier for the coal to biomass conversion is the level of investment costs. In an attempt to overcome this barrier, a project has been developed, aiming at decreasing the investment costs by combining the financial support schemes (subsidies) with using economy of scale effects to be achieved by bundling a number of small projects into one package.
The assumption was that the programme based on "packaging" small biomass projects into bigger ones would:
- make it feasible to monitor the reduction of carbon dioxide, based on the biomass use in each municipality participating in the project.
- improve the local air quality by decreasing local emissions resulting from burning low-quality coal, and often burning waste containing plastics or rubber materials.
- create new local jobs (boiler installation and maintenance, often also biomass harvesting in dedicated energy plantations). At the national level new jobs would be created in boiler manufacturing and related industries.

The project included modernisation of 41**(15-31 kW)** coal fired, into biomass fired heating boilers in residential buildings in the Trzcianne commune. The overall cost of the project was 145.586 PLN, which include: subsidy of 90.000 PLN from NFOSiGW, and 55.586 PLN from the award (award in the contest Our Commune in Europe, 250.000 PLN). Promotion of biomass use in the Trzcianne commune ("Modernisation of 41 coal fired into biomass fired boilers for individual inhabitants, constructing of shed for wood, purchase of chopper and hydraulic splitter") was overall value.
Average per farm biomass consumption is 15 t/a and savings of heating fuel: Coal 10 t/a. Many more farmers wanted to join, but limitation was the available subsidies.

The main advantages of the project are:
- Becoming independent from external supplies of fuel,

- financial savings,
- environmental protection.

The main negative aspects of the project were:

- no continuation because of lack of the support from government;
- no thermal modernisation before investment.

As for the future, huge potential of small project packages dissemination exist, which although requires determined support from the public founds, which were crucial for the success of the project.

3.7.4 - Administrative procedures of authorization necessary in the lead up to project realization

Entities that plan to produce energy from RES have to obtain form President of Polish Energy Regulatory Office the concession on energy production whatever their energy capacity is.

Basic legal documents concern RES use in Poland:

1. Ustawa z dnia 10 kwietnia 1997 r. Prawo energetyczne (Dz. U. z 2007 Nr 42 poz. 276, z późn. zm.) (Energy Law) A main legal act that establishes and regulates rules of energy policy, as well as conditions of supply and use of energy in Poland. The Act defines principles of development of state energy policy, principles and terms of supply and use of fuels and energy, including heat, and operation of energy enterprises, as well as determines organs in charge of fuel and energy economy. The purpose of the Act is the creation of conditions for sustainable development of the country, energy security, efficient and rational use of fuels and energy, development of competition, counteracting negative consequences of natural monopolies, consideration of natural environment protection requirements and obligations stemming from international agreements and balancing interests of energy enterprises and fuel and energy customers.
2. ROZPORZĄDZENIE MINISTRA GOSPODARKI z dnia 14 sierpnia 2008 r. w sprawie szczegółowego zakresu obowiązków uzyskania i przedstawienia do umorzenia świadectw pochodzenia, uiszczenia opłaty zastępczej, zakupu energii elektrycznej i ciepła wytworzonych w odnawialnych źródłach energii oraz obowiązku potwierdzania danych dotyczących ilości energii elektrycznej wytworzonej w odnawialnym źródle energii (Dz. U. z dnia 28 sierpnia 2008 r.) (An ordinance of the Ministry of Economy from 14 August 2008 (Dz. U. 2008 r. Nr 156 poz. 969) about detailed responsibilities of obtaining and presenting certificates of origin, substitute charge pay, purchase of electric energy and heat generated in renewable energy sources, as well as an obligation of data confirmation (for energy generated in renewable source of energy).
3. Rozporządzenie Ministra Gospodarki z dnia 4 maja 2007 r. w sprawie szczegółowych warunków funkcjonowania systemu elektroenergetycznego (Dz. U. z 2007 r. Nr 93, poz. 623 z późn. zm.) (An Ordinance of the Ministry of Economy

dated 04 May 2007 year regarding detailed conditions of an energy system functioning.

4. Polityka energetyczna Polski do 2030 roku. (Energy policy of Poland till 2030 year).
5. Ustawa z dnia 25 sierpnia 2006 r. o biokomponentach i biopaliwach ciekłych (Dz. U. 2006 Nr 169 poz. 1199, z późn. zm.) (An Act on biocomponents and liquid biofuels).
6. Wieloletni program promocji biopaliw lub innych paliw odnawialnych na lata 2008-2014, MP nr 53 2007 (A long term program for biofuels promotion and other renewable fuels in years 2008 - 2014, with defined share of biofuels on transport fuel market).
7. Ustawa z dnia 27 kwietnia 2001r. - Prawo ochrony środowiska (Dz. U. z 2008 r. Nr 25 poz. 150) (Act on an environmental protection dated 12 April 2001 year).
8. Rozporządzenie Ministra Środowiska z dnia 20 grudnia 2005 r. w sprawie standardów emisyjnych z instalacji (Dz. U. Nr 260, poz. 2181, z późn. zm.) (An Ordinance of the Ministry of Environment of 20 December 2005 year concerning installation emission standards).
9. Rozporządzenie Ministra Środowiska z dnia 16 stycznia 2008 r. w sprawie szczegółowych warunków udzielania pomocy publicznej na przedsięwzięcia będące inwestycjami związanymi z odnawialnymi źródłami energii (Dz. U. Nr 14 poz. 89). (An Ordinance of the Ministry of Environment dated 16 January 2008 year about detailed conditions of providing a public support on undertakings being investments in renewable energy sources) .
10. Ustawa z dnia 16 kwietnia 2004 r. o ochronie przyrody (Dz. U. Nr 92, poz. 880 z późn. zm) (An Act on environment protection). Act of 16 April 2004 year about a environmental protection).
11. Rozporządzenie Ministra Środowiska z dnia 21 lipca 2004 r. w sprawie obszarów specjalnej ochrony ptaków Natura 2000 (Dz. U. Nr 229, poz. 2313, z późn. zm.) (An Ordinance of the Ministry of Environment dated 21 July 2004 year about special birds protection programs Natura 2000).
12. Ustawa z dnia 22 grudnia 2004 r. o handlu uprawnieniami do emisji do powietrza gazów cieplarnianych i innych substancji (Dz. U. Nr 281, poz. 2784) (An Act dated 22 December 2004 year about trading rights of greenhouse and other substances gases emission into air).
13. Rozporządzenie Ministra Środowiska z dnia 12 stycznia 2006 r. w sprawie sposobu monitorowania wielkości emisji substancji objętych wspólnotowym systemem handlu uprawnieniami do emisji (Dz. U. Nr 16, poz. 124). (An Ordinance of the Ministry of Environment dated 12 January 2006 year about a way of monitoring of a emission level of substances covered by a common trading rights system).

14. Rozporządzenie Ministra Środowiska z dnia 7 marca 2006 r. w sprawie informacji wymaganych do opracowania krajowego planu rozdziału uprawnień do emisji (Dz. U. Nr 43, poz. 308). (An Ordinance of the Ministry of Environment dated 07 March 2006 year regarding information required to draw up a national plan of emission rights distribution).
15. Ustawa z dnia 25 sierpnia 2006 r. z o systemie monitorowania i kontrolowania jakości paliw (Dz. U. Nr 169 poz. 1200) (Act of 25 August 2006 year about fuels monitoring and quality control system).
16. Ustawa z dnia 27 marca 2003 r. o planowaniu i zagospodarowaniu przestrzennym **(**Dz. U. Nr 80, poz. 717 z późn. zm.) (An Act dated on 27 March 2003 year about spatial planning and development).
17. Ustawa z dnia 26 stycznia 2007 r. o płatnościach do gruntów rolnych i płatności cukrowej (Dz. U. Nr 35, poz. 217, z późn. zm.) (An Act dated 26 January 2007 year about subsidies to arable lands and sugar payment).
18. Ustawa z dnia 30 kwietnia 2004 r. o postępowaniu w sprawach dotyczących pomocy publicznej (Dz. U. z 2007 r. Nr 59, poz. 404.) (An Act of 30 April 2004 year about rules of conduct in cases of public aid).
19. Rozporządzenie Rady Ministrów z dnia 22 grudnia 2006 r. w sprawie ustanowienia programu pomocowego w zakresie regionalnej pomocy publicznej na niektóre inwestycje w ochronie środowiska (Dz. U. Nr 246 poz. 1795 z późn. zm.) (An Ordinance of the Council of Ministers dated 22 December 2006 year about establishing of an aid program in a scope of a regional public aid in some cases investments in environmental protection).
20. Ustawa z dnia 6 grudnia 2006 r. o zasadach prowadzenia polityki rozwoju (Dz. U. Nr 227 poz. 1658 z późn. zm.) (An Act of 06 December 2006 year about development policy rules).
21. Ustawa z z dnia 27 kwietnia 2001 r. o odpadach (Dz. U. z 2007 r. Nr 39, poz. 251 i Nr 88, poz. 587 oraz z 2008 r. Nr 138, poz. 865). (An Act on Waste dated 27.4.2001).
22. Regulation of the Ministry of Environment of 07 September 2001 on the catalogue of wastes, Dz.U. 2001, No 112, item 1206 .
23. The strategy of renewable energy development was issued in 2000 year and accepted by the Polish Parliament on 23 August 2001 year. In the strategy quantity goal was determined – increasing the amount of renewable energy in a fuel-energy balance of the country up to 7,5 per cent in 2010 year in accordance with an act of the Ministry of Economy concerning electric energy and heat purchase from unconventional sources including renewable sources.

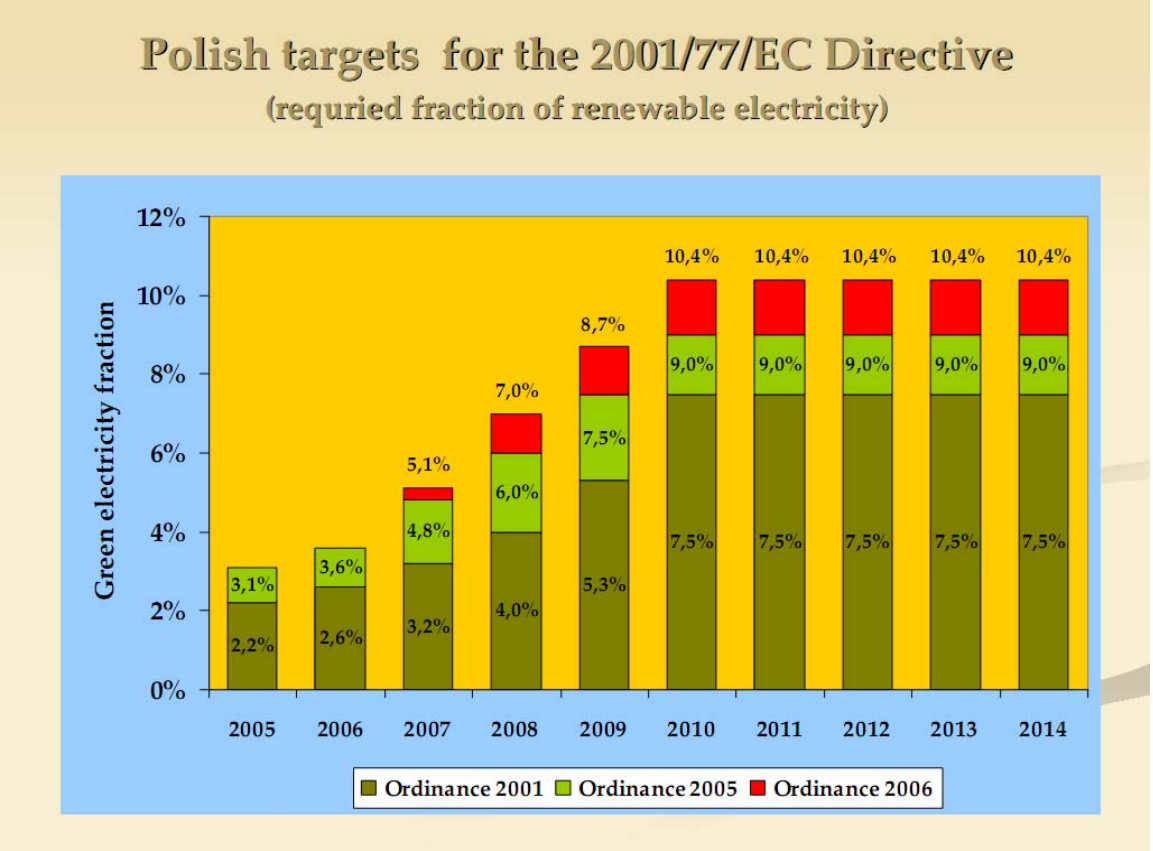
3.7.5 Lesson Learned

The specific feature of biomass as a renewable energy resource is the variety of possibilities in can be produced and used:

- on one hand, of the input biomass material, and
- on the other hand, of the final energy applications that can be derived from a given kind of the biomass material

Biomass can be transformed into gas or liquid fuels or can be used in the solid form, either directly (eg. log wood, or straw bales) or as pellets, briquettes, etc. As a transformed fuel, biomass can cover a wide spectrum of final energy applications: It can be converted to motor biofuels to provide mechanical power, can be used for electricity generation or for heating.
At the same time, it is obvious that **biomass is a limited resource** (contrary to what some people seem implicitly to assume). Its potential in a given area is determined by the available land area, soil quality, climate, etc., but also by financial resources available for investment.
Therefore, it is usually not possible to satisfy simultaneously all energy needs (electricity, heat, transportation) using this resource alone, the more that we need biomass also for food and fodder or for industrial uses. Additionally, not all accessible land can be used to cultivate or harvest plants for energy use. We need land also for preserving biodiversity and for recreation.
Unfortunately, Poland provides an example of misuse (or largely sub-optimal use) of solid biomass resources (and of public money for supporting it). This example is using solid biomass for power generation (mostly in pulverised coal boilers).
This trend has been driven by the requirement to fulfil the obligations following from the EuropeanDirective2001/77/EC (Fig.1).

Fig.1. Polish targets for 2001/77/EC Directive



However increasingly many experts believe that co-firing of biomass with coal for power generation is WASTE of money and of the biomass resources. Additionally, co-combustion generates technical problems, especially dramatically increases slagging of ash and fractional remainder of the ground material on the sheaves of the grinding mill.

Fig.2. Slagging of ash

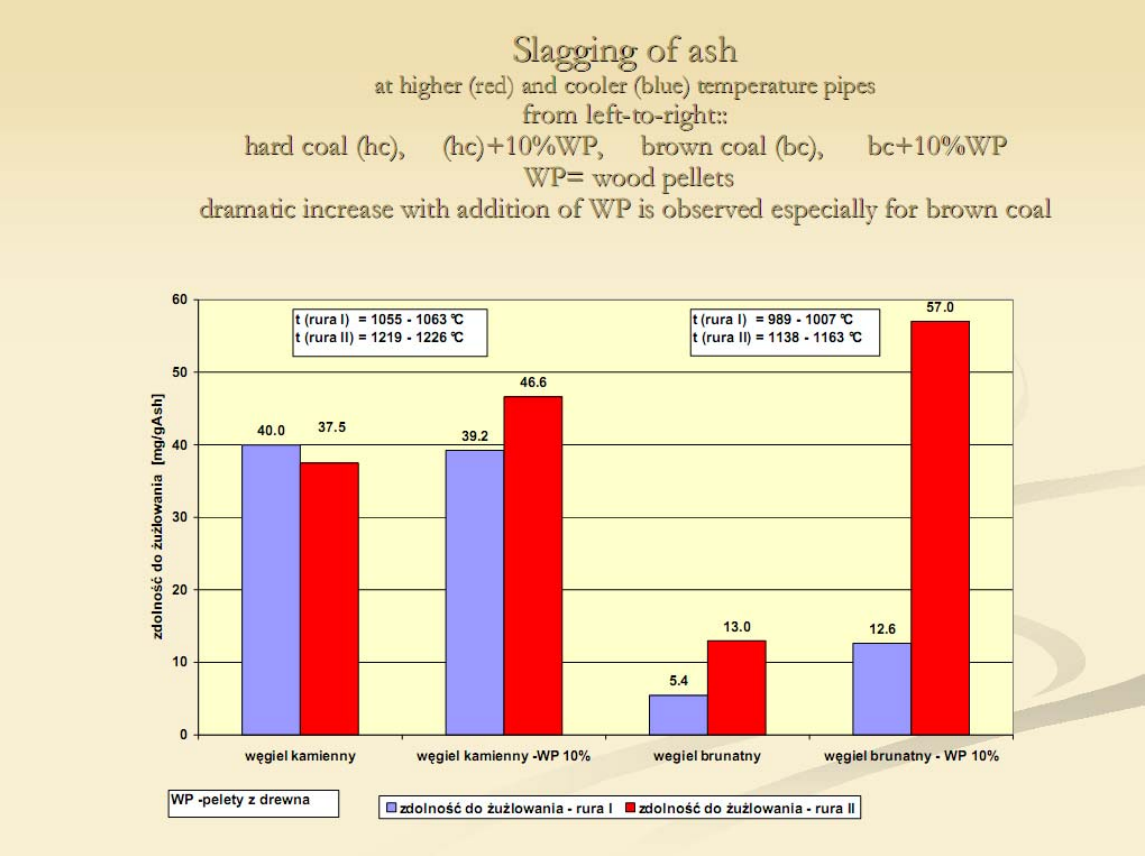
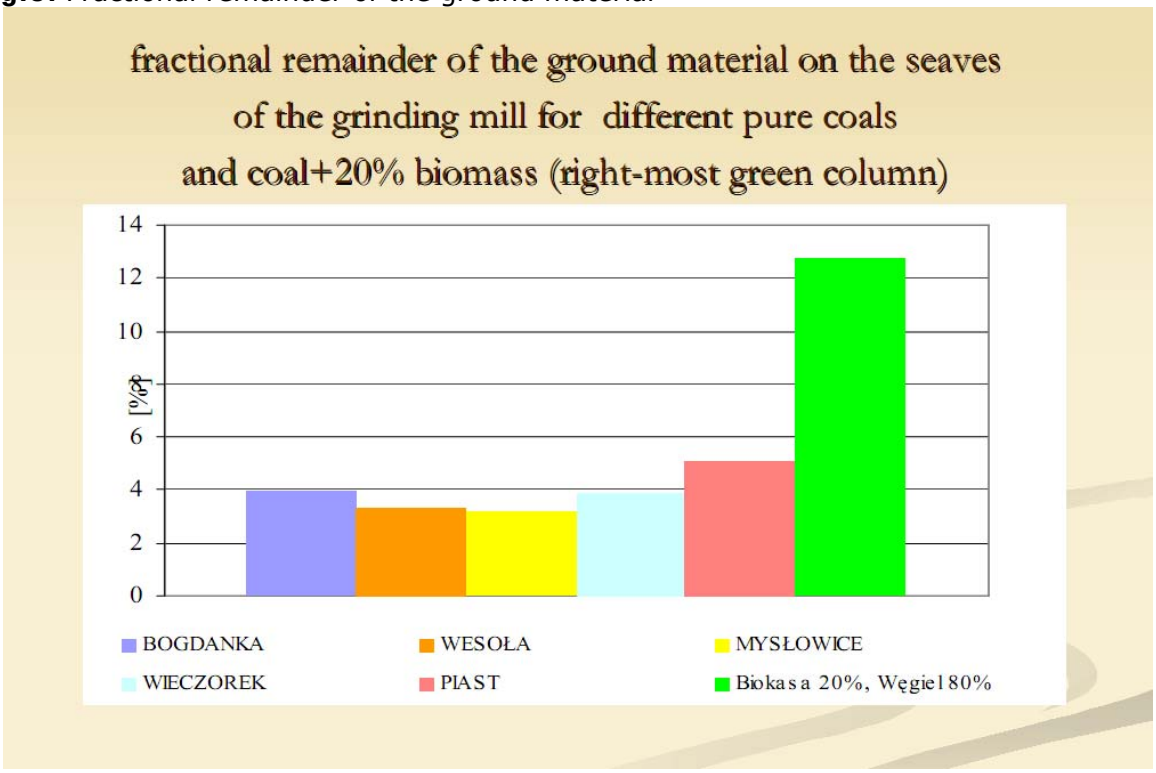


Fig.3. Fractional remainder of the ground material



Therefore, we should attempt to make the best possible choice, given the criteria which have been previously defined. This means that we are facing a typical optimisation problem of finding a minimum (or maximum) of a defined goal function, under the given boundary conditions. To achieve that, an appropriate tool (mathematical model) is needed to support the decision-making process. Such tool should be sufficiently universal and usable at different decision-making levels, including the local ones. i.e. it should be sufficiently simple and user-friendly.
The goal function(s), i.e. the function that one is looking for an optimum of (maximum or minimum) can obviously be different, depending on the specific interest of the particular decision-makers: One can consider a task of finding for which values of the variables under consideration a maximum is reached of, for example:

- reduction of GHG emissions, which is of a global concern,
- fossil fuel substitution (motor fuels, gas), which typically is of national concern,
- extracted energy (attempts to achieve energy self-sufficiency of an area, e.g. an island),
- revenue (cash, tradable certificates, etc.), which would be typical for an individual interest or concern of a local authority

Alternatively, one can try to find where minimum is reached of, for example: the costs of achieving the assumed goals (assumed CO2 emission reduction) or minimum of land requirements for energy plantations.

Such model would provide the needed analytical guidance in the decision-making process. Otherwise, there is a risk of taking suboptimal or even clearly wrong decisions, which may be "orthogonal" to the original goals for which the decisions are actually made.
Examples of such situations are illustrated e.g. in [10, 11].

One should note that there have been attempts to approach this problem. An example is the Invert model [12] developed within the Altener Programme of the EU. In this model also other renewable energy sources and energy efficiency measures had been taken into consideration to find the best solution for allocation of public money to support the particular categories of climate friendly energy-related investments.
However, with such a wide range of possibilities the task becomes exceedingly complex. The search has to be performed in a multidimensional space, where the number of dimensions is very high. The answers become highly ambiguous, due to appearance of complex correlations and inherent uncertainties of the input parameters.

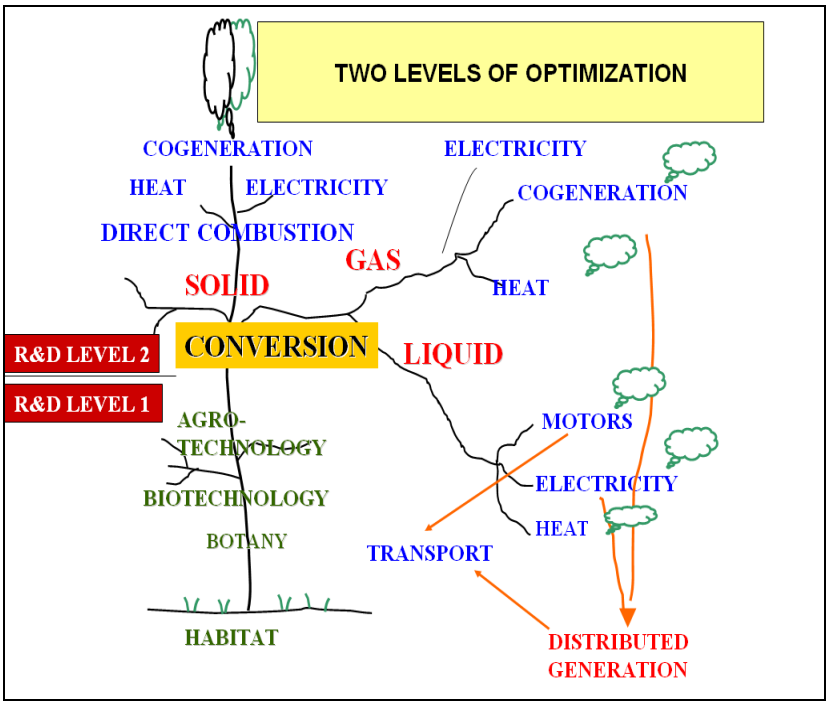
What is needed is to make task simpler, which can be done by reducing the number of dimensions of the space to biomass-related variables only. However, even then the task will certainly remain remarkably complex, although, sure, much simpler. From the technical point of view, it may require searching for the optima in subspaces chosen based on expert intuition and knowledge. The same applies to setting the boundaries of the regions, where the "physical" solutions should be sought for at the start of the runs.

The optimization task can be divided into two interlinked levels (see Fig. 4)

(i) biomass production level (Level 1 in Fig.1), where optimisation of biomass supply potential will be done in terms, e.g., of total primary energy that can be derived from a defined, available area, given the agricultural parameters characterising this area

(ii) biomass conversion level (Level 2 in Fig.1), where optimum is sought in the space of the physical / chemical and technological parameters, given the "boundary condition" determined at level 1.

Fig.4. Two levels of optimisation



Of course, in practice, the boundary conditions from level 1 will usually vary depending on the goal function assumed, which will be subject of policy decision.
Such model still remains to be developed. Otherwise we shall continue to take suboptimal or clearly wrong decisions, sometimes driven by the EU regulations [13].

3.7.6 - Renewable Energy principal actors

Key actors on Polish energy sector:

1. the Ministry of Economy, Director of the Energy Department,
2. the Ministry of Agriculture and Rural Development, Director of the Agricultural Markets Department,
3. the Ministry of Environment,
4. the President of Energy Regulatory Office.

Formally does not exist inter-ministerial working group, but Energy Department from the Ministry of Economy closely cooperates with the Agricultural Markets Department of Ministry of Agriculture and Rural Development, with the Ministry of Environment and with the President of Energy Regulatory Office.

List of institution working in the area of RES:

1. Europejskie Centrum Energii Odnawialnej EC BREC
   02-532 Warszawa, ul. Rakowiecka 32, tel./fax 0-22 848-48-32
   80-761 Gdańsk, ul. Reduta Żbik 5, tel. 0-58 301-57-88
2. Krajowa Agencja Poszanowania Energii
   00-560 Warszawa, ul. Mokotowska 35, tel. 0-22 626-09-10

3. Ogólnopolskie Forum Odnawialnych Źródeł Energii
   25-001 Kielce 1, ul. Szwoleżerów 37, tel. 0-41368-72-54
4. Polska Geotermalna Asocjacja
   31-261Kraków, ul. Wybickiego 7, tel. 0-12 632-2435
5. Polskie Stowarzyszenie Energetyki Wiatrowej
   71-324 Szczecin, Al. Wojska Polskiego 154, tel. 091 48 77 535, fax 091 48 75 014
6. Polskie Towarzystwo Biomasy POLBIOM
   02-532 Warszawa, ul. Rakowiecka 32, tel. 0-22 849-32-31/ 279, fax 832-41-29
7. Polskie Towarzystwo Energetyki Słonecznej - ISES
   00-049 Warszawa, ul. Świętokrzyska 21, tel. 0-22 826-97-77, fax 826-98-15
   Fotowoltaika Polska PVPL
8. Polskie Towarzystwo Energetyki Wiatrowej
   ul. Jaśkowa Dolina 75, 80-286 Gdańsk,
   tel: 58 342 2569, fax: 58 342 2979
   e-mail: ptew@ptew.pl.
9. Towarzystwo Rozwoju Małych Elektrowni Wodnych
   ul. Królowej Jadwigi 1 86-300 Grudziądz
   sekretariat: ul. Rybacka 14 86-300 Grudziądz
   tel. 056-46-49-644 fax. 056-46-49-643
   e-mail: biuro@trmew.pl www: www.trmew.pl
10. Towarzystwo Wspierania Elektrowni Wiatrowych Vis Venti
    71-324 Szczecin, Al. Wojska Polskiego 154, tel. 0-91 48-77-535, fax 48-75-014
11. Towarzystwo Rozwoju Małych Elektrowni Wodnych
    86-300 Grudziądz, ul.Królowej Jadwigi 1, tel.0-56 4649644; fax.0-56 4649643
12. Polska Izba Gospodarcza Energii Odnawialnej
    02-683 Warszawa, UL. Gotarda 9
    Tel. +48 (22) 548 49 99, fax +48 (22) 548 49 98
    www.pigeo.pl e-mail: pigwo@pigeo.pl

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